CLAIM OR CLAIMS

1. A non-immersive virtual image display for combining image light and ambient light comprising:

a housing;

an image source and a reflective focusing optic supported by the housing and aligned along a common optical axis;

a viewing aperture and an ambient-light-admitting aperture formed in the housing and aligned along a viewing axis that is inclined to the common optical axis;

a beamsplitter supported by the housing at an intersection of the common optical axis and the viewing axis; and

the beamsplitter being positioned for:

(a) transmitting image light between the image source and the reflective focusing optic along the common optical axis,

(b) reflecting the transmitted image light between the reflective focusing optic and the viewing aperture along the viewing axis, and

(c) transmitting ambient light between the ambient-light-admitting aperture and the viewing aperture along the viewing axis superimposed upon the transmitted image light that is reflected along the viewing axis.

2. The display of claim 1 in which the reflective focusing optic is fully reflective.

3. The display of claim 1 in which the common optical axis extends in a substantially horizontal direction within a transverse plane that intersects an observer's eyes and that includes the viewing axis.

4. The display of claim 2 in which the beamsplitter includes an interface at which incident light is transmitted and reflected, and the beamsplitter interface extends substantially normal to the transverse plane.

5. The display of claim 2 in which the image source includes an output plane that extends substantially normal to the transverse plane.

6. The display of claim 1 further comprising an ambient-light-admitting adjuster that regulates the amount of ambient light transmitted between the ambient-light-admitting aperture and the viewing aperture along the viewing axis.

7. The display of claim 6 in which both the beamsplitter and the ambient-light-admitting aperture are polarization sensitive, and the ambient-light-admitting adjuster varies polarization sensitivities between the beamsplitter and the ambient-light-admitting aperture.

8. The display of claim 6 in which both the beamsplitter and the ambient-light-admitting aperture are associated with polarizers, and the ambient-light-admitting adjuster varies a relative angular orientation of the ambient-light-admitting aperture polarizer with respect to the beamsplitter polarizer.

9. The display of claim 1 in which the beamsplitter is polarization sensitive and further comprising a phase adjuster for rotating polarization of the image light transmitted through the polarization-sensitive beamsplitter en route to and from the reflective focusing optic.

10. The display of claim 1 further comprising an optically active component located between the ambient-light-admitting aperture and the beamsplitter for altering the ambient light that is combined with the transmitted image light along the viewing axis.

11. The display of claim 10 in which the optically active component is an optical filter.

12. The display of claim 10 in which the optically active component is a lens.

13. The display of claim 10 in which the optically active component is a polarizer.

14. A non-immersive virtual display for combining image light and ambient light comprising:

a housing having an ambient-light-admitting aperture and a viewing aperture;

an image source;

a reflector;

the housing enclosing optical transmissions of (a) image light from the image source to the reflector along a first optical pathway and (b) ambient light from the ambient-light-admitting aperture to the viewing aperture along a second optical pathway;

a beamsplitter located at an intersection of the first and second optical pathways supporting the transmissions of (a) image light from the image source to the reflector along the first optical pathway and (b) ambient light from the ambient-light-admitting aperture to the viewing aperture along a second optical pathway; and

the beamsplitter also supporting reflection of the transmitted image light from the reflector to the viewing aperture for combining the transmitted image light with the transmitted ambient light along the second optical pathway.

15. The display of claim 14 further comprising an ambient-light-admitting adjuster that regulates the amount of ambient light transmitted from the ambient-light-admitting aperture to the viewing aperture along the second optical pathway.

16. The display of claim 15 in which the beamsplitter is polarization sensitive and further comprising a polarization-sensitive component along the second optical pathway between the beamsplitter and the ambient-light-admitting aperture, and the ambient-light-admitting adjuster relatively varies the polarization sensitivities of the polarization sensitive component with respect to the beamsplitter.

17. The display of claim 16 in which the polarization-sensitive component is a polarizer and the ambient-light-admitting adjuster provides for rotating the polarizer.

18. The display of claim 14 in which the beamsplitter is polarization sensitive and further comprising a phase adjuster for rotating polarization of the transmitted image light en route to and from the reflector.

19. The display of claim 14 further comprising an optically active component located between the ambient-light-admitting aperture and the beamsplitter for altering the ambient light that is combined with the transmitted image light along the viewing axis.

20. The display of claim 19 in which the optically active component is an optical filter.

21. The display of claim 19 in which the optically active component is a lens.

22. The display of claim 19 in which the optically active component is a polarizer.

23. A micro-display engine comprising:

an image source and a reflective focusing optic aligned along a common optical axis;

a viewing aperture aligned with a viewing axis that is inclined to the common optical axis;

a polarization-sensitive beamsplitter located at an intersection of the viewing axis and the common optical axis;

a phase adjuster located along the common optical axis between the polarization-sensitive beamsplitter and the reflective focusing optic; and

the polarization-sensitive beamsplitter being arranged for transmitting image light generated by the image source along the common optical axis toward the reflective focusing optic;

the phase adjuster being arranged for rotating polarization of the image light transmitted through the polarization-sensitive beamsplitter en route to and from the reflective focusing optic; and

the polarization-sensitive beamsplitter being arranged for reflecting the polarization-rotated image light along the viewing axis toward the viewing aperture.

24. The engine of claim 23 in which the common optical axis extends in a substantially horizontal direction within a transverse plane that intersects an observer's eyes and that includes the viewing axis.

25. The engine of claim 24 in which the beamsplitter includes an interface at which incident light is transmitted and reflected, and the beamsplitter interface extends substantially normal to the transverse plane.

26. The engine of claim 24 in which the image source includes an output plane that extends substantially normal to the transverse plane.

27. The engine of claim 23 in which the image source includes a controllable polarization rotator that is responsive to the application of a control signal for varying local polarization characteristics in an output plane and a polarizer that cooperates with the polarization rotator for producing a polarized image.

28. The engine of claim 27 in which the polarizer is spaced from the output plane.

29. The engine of claim 28 in which polarizer is incorporated into the polarization-sensitive beamsplitter.

30. The engine of claim 28 in which the reflective focusing optic forms a magnified virtual image of the output plane visible along the viewing axis.

31. The engine of claim 23 in which the image source includes a controllable polarization rotator that is responsive to the application of a control

signal for varying local polarization characteristics in an output plane and first and second polarizers straddling the polarization rotator for producing a polarized image.

32. The engine of claim 31 in which the reflective focusing optic forms a magnified virtual image of the output plane visible along the viewing axis, and the second polarizer is spaced from the output plane outside the depth of field of the reflective focusing optic.

33. A micro-display engine comprising:

an image source including a controllable polarization rotator that is responsive to the application of a control signal for varying local polarization characteristics in an object plane for encoding an image and a polarizer that cooperates with the polarization rotator for converting the encoded image into a visible image;

an at least partially reflective focusing optic that forms a magnified virtual image of the object plane; and

the polarizer being spaced from the object plane along an image path of the reflective focusing optic for filtering light emitted from the object plane to produce the visible image substantially clear of imageable artifacts of the polarizer.

34. The engine of claim 33 further comprising a beamsplitter that directs image light emitted from the object plane a first direction toward the at least partially reflective focusing optic and that directs the reflected image light in a second direction for viewing.

35. The engine of claim 34 in which the beamsplitter is a polarizing beamsplitter and the polarizer is incorporated into the beamsplitter.

36. The engine of claim 35 further comprising a phase adjuster located between the beamsplitter and the reflective focusing optic.

37. The engine of claim 36 in which the phase adjuster is arranged for rotating polarization of the image light en route to and from the reflective

focusing optic in the first direction so that the polarization rotated image light propagates from the beamsplitter in the second direction.

38. The engine of claim 34 further comprising a housing including a viewing aperture and an ambient-light-admitting aperture aligned in the second direction.

39. The engine of claim 38 further comprising an ambient-light-admitting adjuster that regulates the amount of ambient light transmitted between the ambient-light-admitting aperture and the viewing aperture along the second direction.

40. The engine of claim 39 in which the polarizer is a first of two polarizers, a first of the polarizers being incorporated into the beamsplitter for forming the polarized visible image and a second of the polarizers being located at the ambient-light-admitting adjuster for varying the amount of ambient light reaching the viewing aperture.

41. The engine of claim 40 in which the ambient-light-admitting adjuster varies a relative angular orientation of the first and second polarizers.

42. A virtual imaging display comprising:

an image source including a polarization-rotator that is responsive to the application of a control signal for varying local polarization characteristics of an optical output and a polarizer that cooperates with the polarization-rotator for producing a polarized image;

a magnifier that forms an enlarged image of the optical output of the polarization-rotator; and

the polarizer being spaced from a conjugate focus of the magnifier for filtering the optical output and producing the polarized image.

43. The display of claim 42 in which the polarization rotator has an output plane that is located at a conjugate focus of the magnifier.

44. The display of claim 43 in which the output plane of the polarization rotator is an object plane of the magnifier and the polarized image is a virtual image of the object plane.

45. The display of claim 42 further comprising a beamsplitter that directs the optical output of the polarization rotator to the magnifier and that directs a magnified image of the optical output of the polarization rotator to an observer.

46. The display of claim 45 in which the magnifier is a reflective focusing optic.

47. The display of claim 45 in which the magnifier forms an enlarged virtual image of the optical output of the polarization-rotator.

48. The display of claim 45 in which the beamsplitter is polarization sensitive and also functions as the polarizer.

49. The display of claim 48 further comprising a phase adjuster located between the beamsplitter and the magnifier.

50. The display of claim 49 in which the phase adjuster is arranged for rotating polarization of the optical output of the polarization rotator en route to and from the magnifier in a first direction so that the polarization rotated optical output propagates from the beamsplitter toward the observer in a second direction.

51. An imaging system comprising:

a polarization rotator comprising a plurality of controllable pixels that differentially rotate local polarization of image light appearing as different polarizations in an output plane;

a focusing optic focused on the output plane; and

a polarizer that is located beyond the depth of field of the focusing optic and that filters the different polarizations of the image light for producing an image.

52. The imaging system of claim 51 in which the focusing optic is arranged for producing a virtual image of the output plane.

53. The imaging system of claim 51 in which the focusing optic is a magnifier.

54. The imaging system of claim 51 in which the focusing optic is a reflective focusing optic.

55. The imaging system of claim 54 in which the reflective focusing optic produces an enlarged virtual image of the output plane.

56. The imaging system of claim 51 in which the polarizer is formed as a part of an at least partially reflective optic that directs image light from the output plane to the focusing optic.

57. The imaging system of claim 56 in which the partially reflective optic is a polarizing beamsplitter.

58. The imaging system of claim 56 in which the polarizing beamsplitter provides for directing an image of the output plane from the focusing optic to an observer.

59. An image source of a micro-display engine comprising:

a polarization rotator comprising a plurality of controllable pixels that differentially rotate local polarization of image light encoding an image in an output plane as different polarizations lacking contrast between the different polarizations;

a polarizer that is spaced apart from the output plane along a viewing pathway of the output plane and that filters the different polarizations of the image light for providing a view of the output plane that includes contrast between the different polarizations; and

the polarizer being spaced apart from the output plane by an amount that precludes the appearance of the encoded image as a real image on the polarizer.

60. The imaging system of claim 59 in which the pixels are separately controllable for rotating plane polarized light by different amounts to encode the image in the output plane.

61. The imaging system of claim 60 in which the linearly polarized light from one of the pixels is overlapped by the linearly polarized light from a plurality of adjacent pixels on the polarizer.

62. The imaging system of claim 61 in which the overlapping linearly polarized light on the polarizer appears as elliptical or randomly polarized light.

63. The imaging system of claim 59 further comprising a focusing optic that is focused on the output plane, and the polarizer being located beyond the depth of field of the focusing optic.

64. The imaging system of claim 63 in which the focusing optic is a magnifier.

65. The imaging system of claim 64 in which the focusing optic is a reflective focusing optic for enlarging the image encoded in the output plane as a virtual image in plane polarized light.

66. A micro-display engine comprising:

an image source for producing a real image;

a beamsplitter optically connected to the image source;

a pair of reflective optics optically connected in sequence by the beamsplitter for producing an enlargement of the real image as a virtual image that is visible through the beamsplitter.

67. The engine of claim 66 in which a first optical pathway connects the image source to a first of the pair of reflective optics by one of transmission through and reflection from the beamsplitter.

68. The engine of claim 67 in which a second optical pathway connects the first reflective optic to a second of the pair of reflective optics by the other of transmission through and reflection from the beamsplitter.

69. The engine of claim 68 in which a third optical pathway provides for connecting the second reflective optic with a viewing aperture by the one of transmission through and reflection from the beamsplitter.

70. The engine of claim 69 in which the beamsplitter is a polarizing beamsplitter.

71. The engine of claim 70 in which a first phase adjuster is located along a common portion of the first and second optical pathways between the beamsplitter and the first reflective optic.

72. The engine of claim 71 in which a second phase adjuster is located along a common portion of the second and third optical pathways between the beamsplitter and the second reflective optic.

73. The engine of claim 70 in the image source forms the real image with image light, and the image light propagating along the first optical pathway is polarized before encountering the beamsplitter to avoid directing the image light toward the viewing aperture before encountering the pair of reflective optics.

74. The engine of claim 66 in which one of the reflective optics has a nominally planer reflective surface and the other of the reflective optics has a non-planar reflective surface.

75. The engine of claim 66 in which both of the reflective optics have non-planer reflective surfaces for contributing to the magnification of the virtual image.

76. The engine of claim 75 in which at least one of the reflective optics has an aspheric reflective surface for contributing to a focusing function for enhancing a view of the virtual image.

77. A compound imaging system of a micro-display engine comprising:

a beamsplitter for transmitting and reflecting light in different directions;

first and second reflective optics for imaging light emitted from an image source through a viewing aperture;

a first of optical pathway from the image source to the first reflective optic by one of transmission through and reflection from the beamsplitter;

a second optical pathway connecting the first reflective optic to the second reflective optic by the other of transmission through and reflection from the beamsplitter; and

a third optical pathway for connecting the second reflective optic to the viewing aperture by the one of transmission through and reflection from the beamsplitter.

78. The imaging system of claim 77 in which the beamsplitter is polarization sensitive.

79. The imaging system of claim 78 in which the beamsplitter transmits and reflects the light emitted by the image source in accordance with a polarization state of the light.

80. The imaging system of claim 79 in which the polarizer is a polarizing beamsplitter.

81. The imaging system of claim 80 further comprising a phase adjustment system for sequentially varying the polarization state of the light between encounters with the beamsplitter along the first, second, and third optical pathways.

82. The imaging system of claim 77 in which one of the reflective optics has a nominally planer reflective surface and the other of the reflective optics has a non-planar reflective surface.

83. The imaging system of claim 77 in which both of the reflective optics have non-planer reflective surfaces for contributing to the magnification of the virtual image.

84. The imaging system of claim 83 in which at least one of the reflective optics has an aspheric reflective surface for contributing to a focusing function for enhancing a view of the virtual image.